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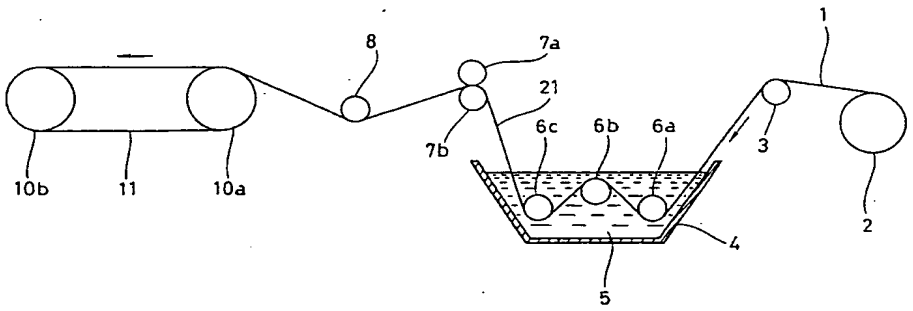
(54) Endless belt for dewatering press.

(57) An endless belt in which a fibrous material (1) is dispersed in a substantially uniform manner all over an endless elastic body layer (30a) is provided. A non-woven tape (1) is impregnated with a polyurethane elastomer material liquid (5) and wound and layered on a supporting belt (11), and then, after curing the polyurethane elastomer material liquid to form an elastic body (30a), it is removed from supporting belt (11).

FIG. 1



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an endless belt which can be used in a press apparatus such as Extended Nip Press or Intensa S Press or the like for dewatering a wet web of paper in a paper making process.

Description of the Background Art

Recently, a so-called shoe press wherein, in a press part of a paper making process, dewatering of a web is carried out by pressing one surface of a web placed on a felt for enhancing the effect of dewatering the web with a rotary roll and pressurizing the other surface through an endless belt with a pressure shoe is becoming popular.

Figs. 12 is a typical cross sectional view illustrating Extended Nip Press as an example of such a press. Referring to Fig. 12, a pressure shoe 41 is arranged under a rotary roll 40. An endless belt 42 for a dewatering press is provided between rotary roll 40 and pressure shoe 41. Endless belt 42 is mounted, wound around guide rolls 43a and 43b and tension rolls 44a, 44b and 44c. A web 45 and felt 46 are passed through between endless belt 42 and rotary roll 40.

If rotary roll 40 is rotated in a direction indicated by arrow A, web 45 placed on felt 46 and endless belt 42 are moved in directions indicated by arrow B and arrow C, respectively. Web 45 and felt 46 are pressed strongly toward rotary roll 40 by pressure shoe 41 in the range of a pressure dewatering part P. Accordingly, web 45 is dewatered in pressure dewatering part P.

Fig. 13 is a typical cross sectional view illustrating Intensa S Press as another example. Referring to Fig. 13, a cylindrical endless belt 52 for a dewatering press is provided under a rotary roll 50. A pressure shoe 51 pressing toward rotary roll 50 through endless belt 52 is provided inside endless belt 52. A web 54 and a felt 53 are passed through between endless belt 52 and rotary roll 50. A pressure dewatering part P having a large width is formed between rotary roll 50 and pressure shoe 51. Web 54 is dewatered in pressure dewatering part P.

The following are endless belts for dewatering presses conventionally proposed for such shoe presses.

(1) a belt in which synthetic resin such as polyurethane resin or rubber is impregnated into a base fabric of an endless belt from one of its surfaces (hereinafter referred to as a single coat type belt: U.K. Patent No. 2, 106,555, U.K. Patent No. 2,106,557 and so forth)

(2) a belt in which an endless base fabric is embedded in a layer of synthetic resin or rubber (hereinafter referred to as a base fabric embedded belt: European Patent No. 194,602 and so forth)

(3) a belt in which synthetic resin such as polyurethane resin or rubber is impregnated into an endless base fabric from both of its front and rear surfaces, and grooves are formed on the surface (hereinafter referred to as a double coat type grooved belt: U.S. Patent No. 4,559,258, U.S. Patent No. 4,908,103, U.S. Patent No. 4,946,731 and so forth)

However, the above-described conventional endless belts for dewatering presses have problems as follows.

(a) Since all of the single coat type belt, the base fabric embedded belt, and the double coat type grooved belt use an endless base fabric impregnated with synthetic resin or rubber, the strength of the bond between the base fabric and the synthetic resin or rubber is little in those belts.

Particularly, in a case where layers on both of the front and rear surfaces of the double coat type grooved belt are formed by a casting method, synthetic resin or rubber gets inside the base fabric from one of the surfaces. Accordingly, it is not possible to make synthetic resin or rubber get inside the base fabric when the opposite surface is formed, so that an anchoring effect cannot be obtained, and it is not possible to obtain large bond strength. Therefore, there was a problem that, as the belt is used, a breaking away phenomenon is caused between the base fabric and the synthetic resin or the rubber to make the life of the belt relatively short.

(b) An endless base fabric is normally formed of monofilaments such as polyamide fiber, polyester fiber, or the like. Such fiber is generally a material having hardness higher than the hardness of synthetic resin or rubber. Therefore, when the endless base fabric is bent during traveling of a belt, the endless base fabric tends to be subject to concentration of stress, and a breaking away phenomenon tends to occur between the base fabric and the synthetic resin or the rubber. The life of the conventional belt is also made relatively short for this reason.

(c) Since the double coat type grooved belt is provided with grooves on its surface, moisture generated

by dewatering of a web is held in the grooves. Therefore, the double coat type grooved belt has superior dewatering efficiency as compared with the single coat type belt. However, the double coat type grooved belt is formed from both of its front and rear surfaces by the casting method or the like using synthetic resin or rubber. When one surface is formed after formation of the other surface, the texture of the base fabric is already tight, so that bubbles in a coating material do not disappear easily, and it tends to be formed with the bubbles remaining. Accordingly, in the case of the double coat type grooved belt, such bubbles tend to be left in the resin or the rubber. If such a belt is used, white water which is pressurized during pressurizing of a rotary roll permeates from the bottom part of the grooves into the bubbles and further permeates from the bubbles into the base fabric. As a result, the breaking away phenomenon between the base fabric and a coating layer occurs at relatively early time to shorten the life of the belt.

(d) In addition, the conventional endless belts use endless base fabric. The tensile force of filaments in endless base fabric is often not uniform, and it often happens that the base fabric is distorted in the belt in a manufacturing process thereof. Therefore, the whole belt tends to receive the distortion and is deformed, or wrinkles or the like tend to be generated.

SUMMARY OF THE INVENTION

An object of the present invention is to solve such conventional problems and provide an enduring endless belt for a dewatering press in which no breakdown such as the breaking away phenomenon occurs and which can be used stably for a long time.

An endless belt according to the present invention is characterized in that a fibrous material is dispersed in a substantially uniform manner all over a cylindrical endless elastic body layer.

According to the present invention, a cylindrical endless elastic body layer can be formed by impregnating a liquid elastic body precursor into a fibrous material and curing the liquid elastic body precursor.

Non-woven fabric may be used, for example, as the fibrous material to be impregnated with the liquid elastic body precursor. No-woven fabric is natural fiber, chemical fiber, glass fiber, metallic fiber, or the like coupled by a chemical or physical method. Such non-woven fabric includes stitch bond non-woven fabric, needle punched non-woven fabric, spun bond non-woven fabric, melt blown non-woven fabric, spun lace non-woven fabric, wet laid process non-woven fabric, chemical bond type dry laid process non-woven fabric, thermal bond type dry laid process non-woven fabric, or air laid type dry laid process non-woven fabric and wet laid process non-woven fabric, or the like.

Organic fiber and/or inorganic fiber is used as the material of a non-woven tape. Polyamide fiber, aromatic polyamide fiber, polyester fiber, polyacrylonitrile fiber, polyvinyl alcohol fiber, polyethylene fiber, polypropylene fiber, polyurethane fiber, polyvinyl chloride fiber, polystyrene fiber, polyfluoroethylene fiber, regenerated cellulose fiber, cotton fiber, or the like is used as the organic fiber.

Glass fiber, metallic fiber, rock fiber, or the like is used as the inorganic fiber. In addition, the non-woven tape may be formed of mixed fiber of organic fiber and inorganic fiber.

According to the present invention, polyurethane elastomer, acrylonitrile-butadiene copolymer, epichlorohydrin rubber, liquid rubber such as liquid polyurethane rubber, liquid nitrile rubber, liquid chloroprene rubber, liquid styrene rubber, liquid butadiene rubber, or the like, thermoplastic elastomer of polyurethane type, polyester type, polyolefin type, or the like, latex such as styrene-butadiene rubber latex, butyl rubber latex, polyurethane rubber latex or the like, or emulsion such as polyurethane rubber emulsion, styrene rubber emulsion, nitrile rubber emulsion, or the like may be used as an elastic body or an elastic body precursor used in an elastic body layer.

Thermoplastic elastomer is made liquid by diluting it with solvent for use and removing the solvent with heat or the like in a manufacturing process. According to the present invention, liquid elastic body precursor includes such thermoplastic elastomer diluted with solvent.

In cases where latex and emulsion are used, a dispersion medium is also removed with heat or the like in a manufacturing process of a belt.

In accordance with a preferred mode of carrying out the present invention, a non-woven tape impregnated with a liquid elastic body precursor is wound and layered in a cylindrical manner and integrated by curing the impregnated elastic body precursor.

In addition, according to the present invention, it is also possible to form a plurality of grooves on an outer peripheral surface of an elastic body layer in a circumferential direction. The grooves may be of a helical shape, a knurled shape, a diagonal lattice-like shape, or the like. It is possible to enhance the dewatering efficiency by forming such grooves as in the case of the conventional double coat type grooved belt.

According to the present invention, the mechanical strength can be reinforced by arranging reinforcing yarn-like bodies in an elastic body layer. The reinforcing yarn-like bodies are preferably arranged along a circumferential direction. In a case where grooves are formed on the outer peripheral surface or the like, the reinforcing yarn-like bodies are preferably arranged inside in the radial direction in the elastic body layer.

According to the present invention, an organic material and/or an inorganic material can be used as the reinforcing yarn-like bodies. Polyamide fiber, aromatic polyamide fiber, polyester fiber, or the like can be used as the organic material. Its shape may be of a bundle of filaments, yarn, roving, a cord, or the like. Glass fiber, metallic fiber, or the like may be used as the inorganic material. Its shape may be of roving, a cord, a wire, or the like.

According to the present invention, the mechanical strength in the circumferential direction and the width direction can be reinforced by arranging a reinforcing net-like material body in an elastic body layer.

According to the present invention, an organic material and/or an inorganic material can be used as the reinforcing net-like material body. Polyamide fiber, polyester fiber, polyvinyl alcohol fiber, or the like can be used as the organic material. Carbon fiber, metallic fiber, glass fiber, or the like can be used as the in organic material. Its shape may be of yarn, a cord, a wire, or the like. The meshes of the reinforcing net-like material body may be lattice-like shaped, lozenge-shaped, for example.

In addition, according to the present invention, the hardness of an elastic body layer in a part outside in the radial direction may be different from the hardness of the elastic body layer in a part inside in the radial direction. For example, it is possible to make the hardness in a part outside in the radial direction higher than the hardness in a part inside in the radial direction.

A manufacturing method according to the present invention includes the step of impregnating a liquid elastic body precursor into a tape-like fibrous material, winding and layering the tape-like fibrous material impregnated with the elastic body precursor on a supporter having an endless peripheral surface, the step of curing the elastic body precursor impregnated in the layered tape-like fibrous material to form an elastic body layer, and the step of removing the elastic body layer from the supporter.

In a case where an endless belt which is long in a circumferential direction such as an endless belt for Extended Nip Press or the like is manufactured, a supporter wherein a supporting belt is provided between a pair of rolls may be used.

In a case where an endless belt which is of a cylindrical shape as a whole and not so long in a circumferential direction such as Intensa S Press or the like is manufactured, a roll may be used as a supporter.

According to a manufacturing method in accordance with the present invention, a tape-like fibrous material impregnated with a liquid elastic body precursor is preferably wound on a supporter in a helical manner. It is possible to shift the tape-like fibrous material with a constant pitch while layering it to obtain an endless belt having a constant thickness with a desirable width.

In a case where an outer peripheral surface of an elastic body layer is cut and ground, it is preferable that the elastic body layer is worked before removed from a supporter. That is, it is preferable that the elastic body layer is cut and ground with the elastic body layer being wound on the supporter.

In addition, in a case where grooves are formed on the outer peripheral surface along a circumferential direction, it is also convenient to work an elastic body layer wound on a supporter.

In order to make it easy to remove an elastic body layer from a supporter, it is preferable that a mold release agent is applied on an endless peripheral surface of the supporter.

In a case where an endless belt in which reinforcing yarn-like bodies are arranged in an elastic body layer is manufactured, it is possible to arrange the reinforcing yarn-like bodies on a tape-like fibrous material to wind the reinforcing yarn-like bodies together with the tape-like fibrous material while winding the tape-like fibrous material on a supporter. In this case, it is possible to set the positions of the reinforcing yarn-like bodies in the elastic body layer of the belt in accordance with the positions of the reinforcing yarn-like bodies on the tape-like fibrous material. For example, it is possible to adjust the positions of the reinforcing yarn-like bodies so that the reinforcing yarn-like bodies are arranged more close to the side of the supporter of the elastic body layer, i.e., inside in the radial direction.

In addition, it is also possible to adjust the degree of reinforcement achieved by reinforcing yarn-like bodies by adjusting the number of the yarn-like bodies during winding of the reinforcing yarn-like bodies together with a tape-like fibrous material.

In a case where an endless belt in which reinforcing net-like material body is arranged in an elastic body layer is manufactured, it is possible to arrange the reinforcing net-like material body on a tape-like fibrous material to wind the reinforcing net-like material body together with the tape-like fibrous material while winding the tape-like fibrous material on a supporter. It is also possible to wind the above tape-like fibrous material on a supporter, then wind reinforcing net-like material body on the fibrous material, and

further wind a tape-like fibrous material thereon.

According to a manufacturing method in accordance with the present invention, a tape-like fibrous material impregnated with a liquid elastic body precursor is wound on a supporter with a predetermined tensile force. The tensile force of winding may be selected suitably. For example, in a case where a non-woven tape having a width of 165mm is used as the tape-like fibrous material, the tensile force of the winding is generally in the range of 5kg to 10kg. The thickness of a belt manufactured by this manufacturing method can be adjusted in various ways. For example, in a case where it is wound on a supporter in a helical manner, it is possible to adjust the thickness of a belt by changing the pitch with which the tape-like fibrous material is shifted. In such a case, generally, it is possible to increase the thickness of the belt by making the pitch smaller, and to reduce the thickness of the belt by making the pitch larger.

In addition, after a tape-like fibrous material is once wound on a supporter, it is possible to further wind a tape-like fibrous material thereon. In this case, it is possible to use a different type of tape-like fibrous material or elastic body precursor to be impregnated. It is also possible to manufacture a belt in which the hardness in the inside part of the belt and the hardness in the outside part of the belt are different by using different types of elastic body precursor or the like, for example, using elastic bodies having different molecular weights in the inside and outside parts of the belt.

According to the present invention, curing of an elastic body precursor can be performed by heating or leaving at room temperature, for example.

It is apparent that working of an endless belt may be performed after it is removed from a supporter. For example, it is possible to cut and grind an outer peripheral surface of the belt after it is removed from the supporter. An inner peripheral surface of the belt may be also cut and ground if necessary.

In an endless belt for a dewatering press in accordance with the present invention, a fibrous material is dispersed in a substantially uniform manner all over an elastic body layer. Therefore, the whole belt is unified, and, unlike the conventional belt, different materials or materials having different strength are not bonded, so that the belt itself is not broken away.

In addition, the whole is uniform, so that stress is also applied uniformly to the whole of it, and it does not happen that large distortion is received inside the belt.

Endless base fabric in which the tensile force of filaments tend to be not uniform is not used, so that the belt is not distorted as in the conventional case.

According a manufacturing process of the present invention, a tape-like fibrous material impregnated with a liquid elastic body precursor is wound and layered on a supporter, and the elastic body precursor is cured to form an elastic body layer. The tape-like fibrous material impregnated with the liquid elastic body precursor is layered and bonded by the liquid elastic body precursor to be integrated. Therefore, the tape-like fibrous material cured after layered is in the state wherein the fibrous material is uniformly dispersed and contained in the elastic body layer.

According to this manufacturing method, it is possible to obtain an endless belt of desired shape and structure freely by changing the shape and size of a supporter or by changing the width of the tape-like fibrous material or the number of layers to be layered. Accordingly, it is possible to manufacture an endless belt adapted to wider application as compared with the conventional endless belt using endless base fabric.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a typical view illustrating a manufacturing apparatus according to a first embodiment of the present invention.

Fig. 2 is a plan view illustrating a state of winding of a non-woven tape on a supporter according to the embodiment illustrated in Fig. 1.

Fig. 3 is a cross sectional view illustrating a belt according to the first embodiment of the present invention.

Fig. 4 is a typical view illustrating a manufacturing apparatus according to a second embodiment of the present invention.

Fig. 5 is a plan view illustrating a state of arrangement of reinforcing yarn on a non-woven tape according to the embodiment illustrated in Fig. 4.

Fig. 6 is a cross sectional view illustrating a belt according to a second embodiment of the present invention.

Fig. 7 is a typical view illustrating a manufacturing apparatus according to a third embodiment of the

present invention.

Fig. 8 is a cross sectional view illustrating a belt according to the third embodiment of the present invention.

Fig. 9 is a typical view illustrating a manufacturing apparatus according to a fourth embodiment of the present invention.

Fig. 10 is a cross sectional view illustrating a belt according to the fourth embodiment of the present invention.

Fig. 11 is a cross sectional view illustrating a belt according to a fifth embodiment of the present invention.

Fig. 12 is a typical cross sectional view illustrating Extended Nip Press apparatus.

Fig. 13 is a typical cross sectional view illustrating Intensa S Press apparatus.

Fig. 14 is a schematic view illustrating a manufacturing apparatus according to a sixth embodiment of the present invention.

Fig. 15 is a plan view illustrating a reinforcing net-like material body on a non-woven tape in the embodiment illustrated in Fig. 14.

Fig. 16 is a cross sectional view illustrating a belt according to the sixth embodiment of the present invention.

Fig. 17 is a schematic view illustrating a manufacturing apparatus according to a seventh embodiment of the present invention.

Fig. 18 is a cross sectional view illustrating a belt according to the seventh embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment 1

Fig. 1 is a typical view illustrating a manufacturing apparatus according to a first embodiment of the present invention. Referring to Fig. 1, a non-woven tape 1 is wound on a feed roll 2, and feed roll 2 is rotated to supply non-woven tape 1. Non-woven tape 1 passes a guide roller 3 and is dipped in polyurethane elastomer material liquid 5 in a tank 4. Three dipping rollers 6a, 6b and 6c are provided in tank 4. Non-woven tape 1 is passed between dipping rollers 6a, 6b and 6c and passed through a polyurethane elastomer material liquid 5 to be impregnated. Non-woven tape 21 impregnated with the polyurethane elastomer material liquid is then passed between squeezing rolls 7a and 7b. It is possible to adjust the amount of the impregnated liquid in impregnated non-woven tape 21 by adjusting the gap between squeezing rolls 7a and 7b suitably. In addition, it is also possible to adjust the thickness of impregnated non-woven tape 21. Then, impregnated non-woven tape 21 is passed through an outer peripheral surface of a tension roll 8 and supplied onto a supporting belt 11 mounted on outer peripheral surfaces of metallic rolls 10a and 10b. Supporting belt 11 according to this embodiment is made of rubber, and a mold release agent is applied on its surface. Metallic rolls 10a and 10b can be formed of iron, stainless steel, or the like.

Fig. 2 is a plan view showing a state of winding of a non-woven tape on a supporter in the embodiment shown in Fig. 1. Referring to Fig. 2, impregnated non-woven tape 21 is wound from one end of supporter 11, shifted with a predetermined pitch. The state shown in Fig. 2 is an intermediate state, and impregnated non-woven tape 21 is wound until it reaches the other end of supporter 11 with impregnated non-woven tape 21 shifted in a transverse direction with a predetermined feed pitch.

According to this embodiment, stitch bond non-woven fabric having a width of 165mm is used as the non-woven tape. A non-woven tape (Bonyarn C-3512TA3: Nippon Non-woven Fabric Company, Ltd.) in which the web is of polyester fiber, the inlaid yarn is of polyamide fiber, and a basis weight is 115g/m^2 is used.

Hiprene - L100 (Trademark: Mitsui Toatsu Chemicals, Inc.) of 100 weight part as a polyurethane prepolymer mixed with 4, 4' methylenebisorthochloroaniline of 12.5 weight part as a curing agent is used as a polyurethane elastomer to be impregnated.

In the winding of the impregnated non-woven tape to the supporter, the feed pitch is 20mm, and the tensile force of winding is 10kg. After the winding of the non-woven tape, the polyurethane elastomer is cured, then its surface is cut and ground, and then removed from the supporter. The thickness of thus manufactured endless belt is about 2.6mm, which is the same as the thickness of the conventional single coat. Its inner circumferential length is 7.62m, and its width is 4.76m.

Fig. 3 is a cross sectional view showing a belt obtained in accordance with this embodiment. Although

the one-dotted chain line in endless belt 30 shown in Fig. 3 shows a layer of a non-woven tape 1, such a boundary surface is not recognized in the final endless belt, and a fibrous material constituting the non-woven tape is contained, dispersed uniformly in a polyurethane elastomer 30a.

Embodiment 2

Fig. 4 is a typical view illustrating a manufacturing apparatus according to a second embodiment of the present invention. Referring to Fig. 4, according to this embodiment, aromatic polyamide fiber 15 is placed on an impregnated non-woven tape 21 when impregnated non-woven tape 21 impregnated with a polyurethane elastomer material liquid 5 is wound on a supporting belt 11. Aromatic polyamide fiber 15 as reinforcing yarn is wound on a feed roll 12 and supplied by rotating feed roll 12. Aromatic polyamide fiber 15 fed from feed roll 12 is passed through an outer-peripheral surface of a guide roll 13, passed through an outer peripheral surface of a tension roll 14, and arranged on non-woven tape 21.

Fig. 5 is a plan view showing the state of arrangement of the reinforcing yarn on the non-woven tape in the embodiment shown in Fig. 4. As shown in Fig. 5, five pieces of reinforcing yarn 15 are arranged parallel with each other with a pitch of about 2mm in a part of about 10mm from the end of impregnated non-woven tape 21.

The same non-woven tape and a polyurethane elastomer as in the case of Embodiment 1 are used. Accordingly, five pieces of reinforcing yarn are arranged in the end part of 10mm in the width of 165mm of the non-woven tape.

A bundle of filaments of aromatic polyamide fiber, Kevlar (Trademark: Du Pont Toray Kevlar, Ltd.), is used as the reinforcing yarn.

The reinforcing yarn is wound on supporting belt 11 with the same tensile force as that of the non-woven tape.

The reinforcing yarn may be also passed through a specially provided polyurethane material liquid, impregnated, and then supplied to supporting belt 11.

The feed pitch of impregnated non-woven tape 21 and reinforcing yarn 15 is 10mm, which is about a half of that in Embodiment 1.

After winding impregnated non-woven tape and reinforcing yarn 15 on the whole of supporting belt 11, the polyurethane elastomer is cured, and its surface is cut and ground. Then, according to this embodiment, grooves along a circumferential direction (i.e., machine direction) are formed on its surface using a rotary cutter. The thickness of the obtained endless belt is about 5.5mm, and its section is as shown in Fig. 6. Referring to Fig. 6, grooves 32 along a circumferential direction are formed on an outer peripheral surface of endless belt 31 according to this embodiment. Reinforcing yarn 15 is arranged inside an elastic body layer as shown in Fig. 6. Although the one-dotted chain line in Fig. 6 also shows the boundary of the non-woven tape, it is not recognized in the final endless belt.

Embodiment 3

Fig. 7 is a typical view illustrating a manufacturing apparatus according to a third embodiment of the present invention. Referring to Fig. 7, a metallic roll 16 is used as a supporter on which an impregnated non-woven tape 21 is wound in this embodiment.

Needle punched non-woven fabric having a width of 165mm is used as the non-woven tape. A non-woven tape (Kurelock NXF-045K: Kureha Ltd.) in which the web is of aromatic polyamide fiber and a basis weight is 450g/m^2 is used.

A polyurethane elastomer liquid which is the same as the one in the case of Embodiment 1 is used.

According to this embodiment, impregnated non-woven tape 21 is wound on metallic roll 16 as a supporter with a feed pitch of 10mm without arranging reinforcing yarn.

After curing, the surface of the belt is cut and ground, and grooves are formed with a rotary cutter in this embodiment as in the case of Embodiment 2.

Fig. 8 is a cross sectional view of thus obtained endless belt. Grooves 34 along a circumferential direction are formed on an outer peripheral surface of an endless belt 33. Its thickness is about 5.5mm.

Embodiment 4

Fig. 9 is a typical view illustrating a manufacturing apparatus according to a fourth embodiment of the present invention. Referring to Fig. 9, according to this embodiment, a metallic roll 16 is used as a supporter as in the case of Embodiment 3, and aromatic polyamide fiber 15 is wound, arranged on an

impregnated non-woven tape 21.

The same non-woven tape as the one used in the case of Embodiment 3 is used. The same polyurethane elastomer as the one used in Embodiment 1 is used. The same bundle of filaments of aromatic polyamide fiber as the one used in Embodiment 2 is used as reinforcing yarn.

The feed pitch of winding is 10mm, and five pieces of reinforcing yarn are arranged parallel with each other with spacing of 2mm in a part of 10mm from the end of the non-woven tape as in the case of Embodiment 2.

After curing the polyurethane elastomer, its surface is cut and ground.

Fig. 10 is a cross sectional view of an endless belt obtained according to this embodiment. Referring to Fig. 10, reinforcing yarn 15 is arranged inside in a radial direction of the endless belt 35. The thickness of the obtained endless belt is about 2.6mm.

Reference Example 1

A polyurethane elastomer material liquid is coated and cured from one surface of endless base fabric by the casting method. At this time, the material liquid is prevented from oozing out to the other surface. The side of the polyurethane surface is cut and ground to form an endless press for a dewatering press of a single coat type having a thickness of 2.6mm.

Reference Example 2

A polyurethane elastomer material liquid is coated and cured on both of the front and rear surfaces of endless base fabric by the casting method to form an endless belt. The side of the front surface is cut and ground, and then grooves are formed with a rotary cutter to form an endless belt for a dewatering press having a thickness of 5.5mm.

A specimen having a width 20mm and a length of 150mm is taken from each of the endless belts for dewatering presses according to the above Embodiments 1-4, and Reference Examples 1 and 2, and the tensile strength and elongation of them were measured similarly to JISK 6301.

Table 1 shows a tensile strength (kg/cm) in a traveling direction, i.e, a circumferential direction.

Table 1

Elongation	1%	5%
Embodiment 1	5.1	18.7
Embodiment 2	53.1	89.0
Embodiment 3	13.2	52.4
Embodiment 4	53.1	74.1
Reference Example 1	10.6	38.3
Reference Example 2	19.6	63.5

Table 2 shows the tensile strength (kg/cm) in the width direction.

Table 2

Elongation	1%	5%
Embodiment 1	2.9	11.5
Embodiment 2	11.0	41.0
Embodiment 3	11.5	42.7
Embodiment 4	7.3	23.6
Reference Example 1	4.1	14.8
Reference Example 2	6.0	25.5

As shown in Tables 1 and 2, the endless belts according to the Embodiments 1-4 of the present invention have strength enough for use, and the ones reinforced with reinforcing yarn have strength approximately equal to or larger than that of the endless belts of the conventional reference examples 1 and 2.

While deformation of a belt, generation of wrinkles in the belt and meandering of the belt are recognized in the endless belts according to Reference Examples 1 and 2, such deformation or meandering are not recognized in the endless belts according to Embodiments 1-4 of the present invention. In addition, in the endless belts according to Embodiments 1-4 of the present invention, the fibrous material is dispersed uniformly in the whole, and no bubbles are recognized in the elastic body layer.

Embodiment 5

Fig. 11 is a cross sectional view illustrating a belt according to a fifth embodiment of the present invention. Referring to Fig. 11, the endless belt 36 is formed of two elastic body layers 36a and 36b. Elastic body layer 36b is formed by further winding an impregnated non-woven tape after the winding for forming elastic body layer 36a is once completed. Accordingly, it is possible to use different types of the fibrous material and/or the elastic body precursor to be impregnated in elastic body layer 36a and elastic body layer 36b. By using such a method, it is possible to form an endless belt in which the hardness of an inside part is different from the hardness in the outside part, for example. For example, it is possible to make the hardness on the side of an outer peripheral surface be Shore hardness A95° and make the hardness on the side of an inner peripheral surface be Shore hardness A90° and so forth.

Embodiment 6

Fig. 14 is a schematic view illustrating a manufacturing apparatus according to a sixth embodiment of the present invention. Referring to Fig. 14, according to this embodiment, a metallic roll 16 is used as a supporter as in the case of Embodiment 4, and a reinforcing net-like material body 37 formed of polyamide fiber is wound, arranged on an impregnated non-woven tape 21.

The same non-woven tape as the one used in Embodiment 1 is used. The same polyurethane elastomer as the one used in Embodiment 1 is used. As illustrated in Fig. 15, yarn formed of polyamide fiber is used as longitudinal linear material bodies 38a and lateral linear material bodies 38b of reinforcing net-like material body 37, and the crossings 39 are fixed temporarily with an adhesive.

The feed pitch of impregnated non-woven fabric 21 is 20mm. As illustrated in Fig. 15, reinforcing net-like material body 37 is arranged in a part of 20mm from the end of impregnated non-woven tape 21. The width of reinforcing net-like body 37 is 40mm.

After curing the polyurethane elastomer, its surface is cut and ground.

Fig. 16 is a cross-sectional view of an endless belt 55 obtained according to this embodiment. As illustrated in Fig. 16, reinforcing net-like body 37 is arranged in a layer of endless belt 55. The thickness of the obtained endless belt is about 2.6mm.

Embodiment 7

Fig. 17 is a schematic view illustrating a manufacturing apparatus according to a seventh embodiment of the present invention. Referring to Fig. 17, according to this embodiment, a supporting belt 11 attached to outer peripheral surfaces of metallic rolls 10a and 10b is used as a supporter as in Embodiment 2, and the same reinforcing net-like material body 37 as the one used in Embodiment 6 is wound, arranged on impregnated non-woven tape 21.

The same non-woven tape as the one used in Embodiment 1 is used. The same polyurethane elastomer as the one used in Embodiment 1 is used.

The feed pitch of an impregnated non-woven fabric is 10mm. Reinforcing net-like material body 37 is arranged in a part of 20mm from the end of impregnated non-woven tape 21 as in the case of Embodiment 6. The width of reinforcing net-like material body 37 is the same as that in Embodiment 6.

After the impregnated non-woven fabric and the reinforcing net-like material body are wound on the whole supporting belt 11, the polyurethane elastomer is cured, and its surface is cut and ground. Then, grooves along a circumferential direction are formed on its surface using a rotary cutter. The thickness of the obtained endless belt is about 5.5mm, and its section is as illustrated in Fig. 18. Referring to Fig. 18, grooves 57 along the circumferential direction are formed on an outer peripheral surface of an endless belt 56 according to this embodiment. Reinforcing net-like material body 37 is arranged in the elastic body layer as illustrated in Fig. 18.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

Claims

1. An endless belt for a dewatering press wherein a fibrous material (1) is dispersed in a substantially uniform manner all over an endless elastic body layer (30a).

2. The endless belt for a dewatering press according to claim 1, wherein said endless elastic body layer (30a) is formed by curing a liquid elastic body precursor impregnated into said fibrous material (1).

3. The endless belt according to claim 1, wherein said elastic body layer (30a) has a cylindrical shape.

4. The endless belt for a dewatering press according to claim 2, wherein said fibrous material (1) is a non-woven tape.

5. The endless belt for a dewatering press according to claim 4, wherein said non-woven tape (21) impregnated with said elastic body precursor is wound and layered in an endless peripheral surface, and said impregnated elastic body precursor is cured to integrate said layered non-woven tape.

6. The endless belt according to claim 5, wherein said endless peripheral surface has a cylindrical shape.

7. The endless belt for a dewatering press according to claim 4, wherein said non-woven tape (1) includes organic fiber.

8. The endless belt for a dewatering press according to claim 7, wherein said organic fiber (1) includes at least one selected from the group consisting of polyamide fiber, aromatic polyamide fiber, polyester fiber, polyacrylonitrile fiber, polyvinyl alcohol fiber, polyethylene fiber, polypropylene fiber, polyvinyl chloride fiber, polystyrene fiber, polyfluoroethylene fiber, polyurethane fiber, regenerated cellulose fiber, and cotton fiber.

9. The endless belt for a dewatering press according to claim 4, wherein said non-woven tape (1) includes inorganic fiber.

10. The endless belt for a dewatering press according to claim 9, wherein said inorganic fiber (1) includes at least one selected from the group consisting of glass fiber, metallic fiber, and rock fiber.

11. The endless belt for a dewatering press according to claim 4, wherein said non-woven tape (1) is formed of mixed fiber of organic fiber and inorganic fiber.

12. The endless belt for a dewatering press according to claim 1, wherein a plurality of grooves (32, 34) are formed on an outer peripheral surface of said elastic body layer in a machine direction.

13. The endless belt for a dewatering press according to claim 12, wherein reinforcing yarn-like bodies (15) are arranged in said elastic body layer.

14. The endless belt for a dewatering press according to claim 13, wherein said reinforcing yarn-like bodies (15) are formed of organic fiber and/or inorganic fiber.

15. The endless belt for a dewatering press according to claim 1, wherein reinforcing yarn-like bodies (15) are arranged in said elastic body layer.

16. The endless belt for a dewatering press according to claim 15, wherein said reinforcing yarn-like bodies (15) are arranged in a machine direction.

17. The endless belt for a dewatering press according to claim 16, wherein said reinforcing yarn-like bodies (15) are arranged inside in a radial direction of said elastic body layer.

18. The endless belt for a dewatering press according to claim 15, wherein said reinforcing yarn-like bodies (15) are formed of organic material and/or inorganic material.

19. The endless belt for a dewatering press according to claim 1, wherein a reinforcing net-like material body (37) is arranged in said elastic body layer.

20. The endless belt for a dewatering press according to claim 12, wherein a reinforcing net-like material body (37) is arranged in said elastic body layer.

21. The endless belt for a dewatering press according to claim 19, wherein said reinforcing net-like material body (37) is formed of organic material and/or inorganic material.

22. The endless belt for a dewatering press according to claim 20, wherein said reinforcing net-like material body (37) is formed of organic fiber and/or inorganic fiber.

23. The endless belt for a dewatering press according to claim 1, wherein said elastic body layer (30a) includes at least one selected from the group consisting of polyurethane elastomer, acrylonitrilebutadiene copolymer, epichlorohydrin rubber, liquid rubber, thermoplastic elastomer, latex, and emulsion.

24. The endless belt for a dewatering press according to claim 1, wherein the hardness of said elastic body layer (36b) outside in a radial direction is different from the hardness of said elastic body layer (36a) inside in the radial direction.

25. The endless belt for a dewatering press according to claim 24, wherein the hardness of said elastic body layer (36b) outside in the radial direction is higher than the hardness of said elastic body layer (36a) inside in the radial direction.

26. A method of manufacturing an endless belt for a dewatering press, comprising the steps of:
impregnating a liquid elastic body precursor (5) into a tape-like fibrous material (1);
winding and layering said tape-like fibrous material (21) impregnated with said elastic body precursor (5) on a supporter (11, 16) having an endless peripheral surface;
curing said elastic body precursor (5) impregnated in said layered tape-like fibrous material (21) to form an elastic body layer (30a); and
removing said elastic body layer (30a) from said supporter (11, 16).

27. The method of manufacturing an endless belt for a dewatering press according to claim 26, wherein said supporter having an endless peripheral surface is a roll (16).

28. The method of manufacturing an endless belt for a dewatering press according to claim 26, wherein

said supporter having an endless peripheral surface includes a pair of rolls (10a, 10b) and a supporting belt (11) provided between said rolls (10a, 10b).

29. The method of manufacturing an endless belt for a dewatering press according to claim 26, wherein said tape-like fibrous material (21) is wound on said supporter (11, 16) in a helical manner.

30. The method of manufacturing an endless belt for a dewatering press according to claim 26, further comprising the step of cutting and grinding an outer peripheral surface of said elastic body layer (30a) with said elastic body layer (30a) being wound on said supporter (11, 16).

31. The method of manufacturing an endless belt for a dewatering press according to claim 30, wherein said step of cutting and grinding includes the step of forming grooves (32, 34) along a circumferential direction on the outer peripheral surface of said elastic body layer (30a) which has been ground.

32. The method of manufacturing an endless belt for a dewatering press according to claim 26, wherein a mold release agent is applied on said endless peripheral surface of said supporter (11, 16).

33. The method of manufacturing an endless belt for a dewatering press according to claim 26, wherein said step of winding said tape-like fibrous material (21) on said supporter (11, 16) includes the step of arranging reinforcing yarn-like bodies (15) on said tape-like fibrous material (21) while winding said tape-like fibrous material (21) on said supporter (11, 16).

34. The method of manufacturing an endless belt for a dewatering press according to claim 26, wherein said step of winding said tape-like fibrous material (21) on said supporter (11, 16) includes the step of arranging a reinforcing net-like material body (37) on said tape-like fibrous material while winding said tape-like fibrous material on said supporter (11, 16).

35. The method of manufacturing an endless belt for a dewatering press according to claim 33, wherein said reinforcing yarn-like bodies (15) are arranged on said tape-like fibrous material (21) to be placed on the side of said supporter (11, 16) when said reinforcing yarn-like bodies (15) are wound on said supporter (11, 16) together with said tape-like fibrous material (21).

36. The method of manufacturing an endless belt for a dewatering press according to claim 26, wherein said step of winding said tape-like fibrous material (21) on said supporter (11, 16) includes the step of further winding a second tape-like fibrous material (21) on said supporter (11, 16) on which the first tape-like fibrous material (21) has already wound.

37. The method of manufacturing an endless belt for a dewatering press according to claim 36, wherein said second tape-like fibrous material (21) further wound on said supporter (11, 16) is impregnated with an elastic body precursor (5) different from said elastic body precursor (5) impregnated in said first tape-like fibrous material (21) wound on said supporter (11, 16).

38. The method of manufacturing an endless belt for a dewatering press according to claim 26, wherein said tape-like fibrous material (1) is a non-woven tape.

FIG. 1

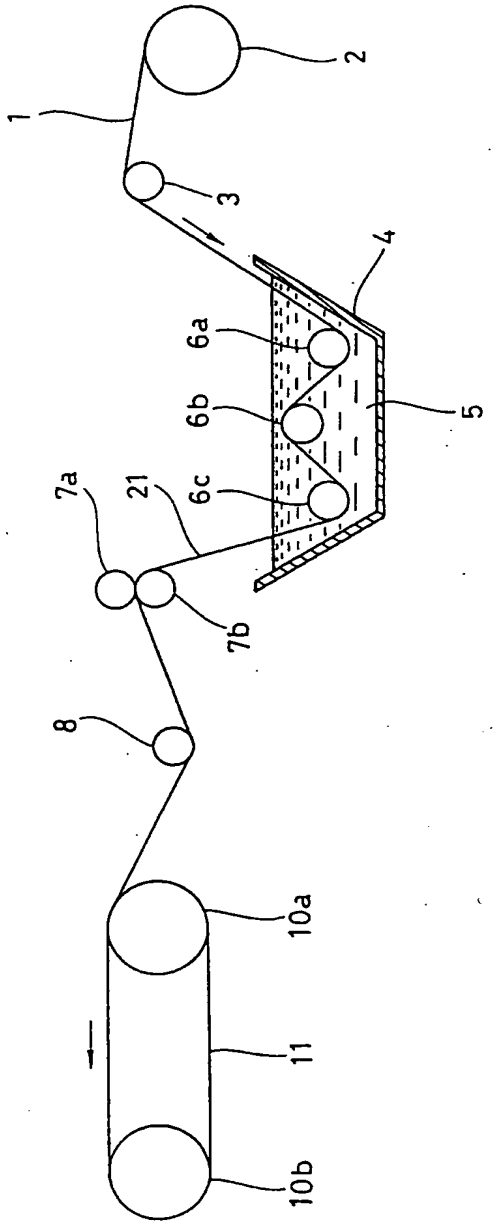


FIG. 2

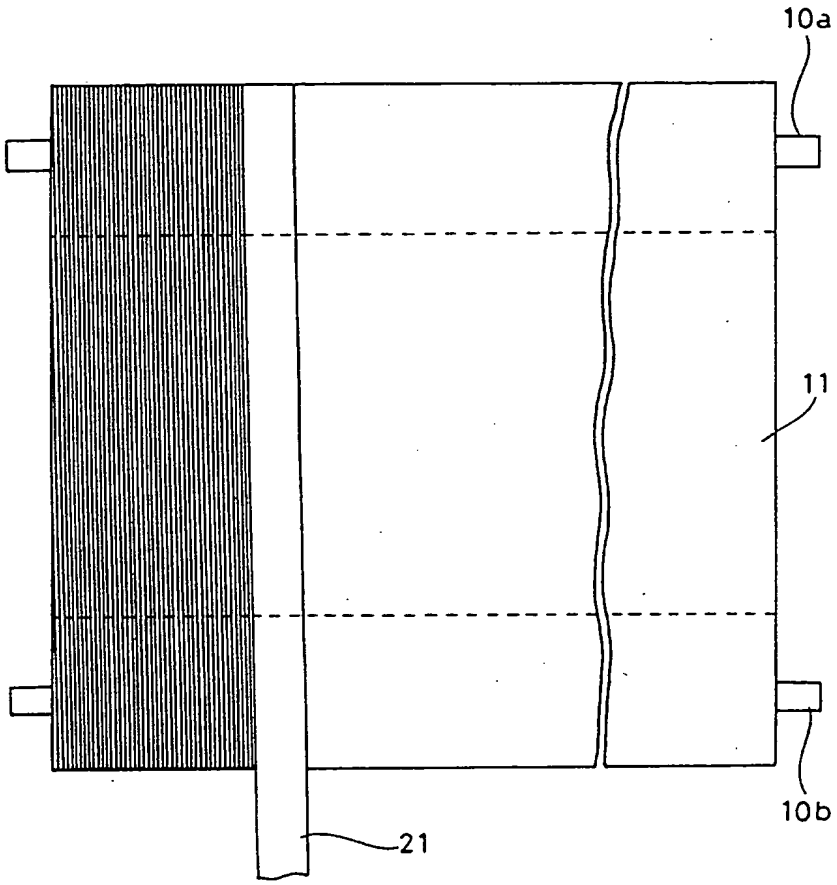


FIG. 3

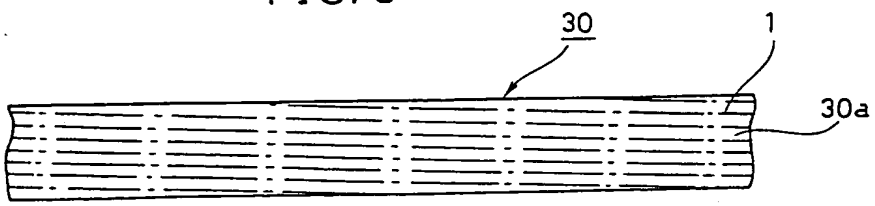


FIG. 4

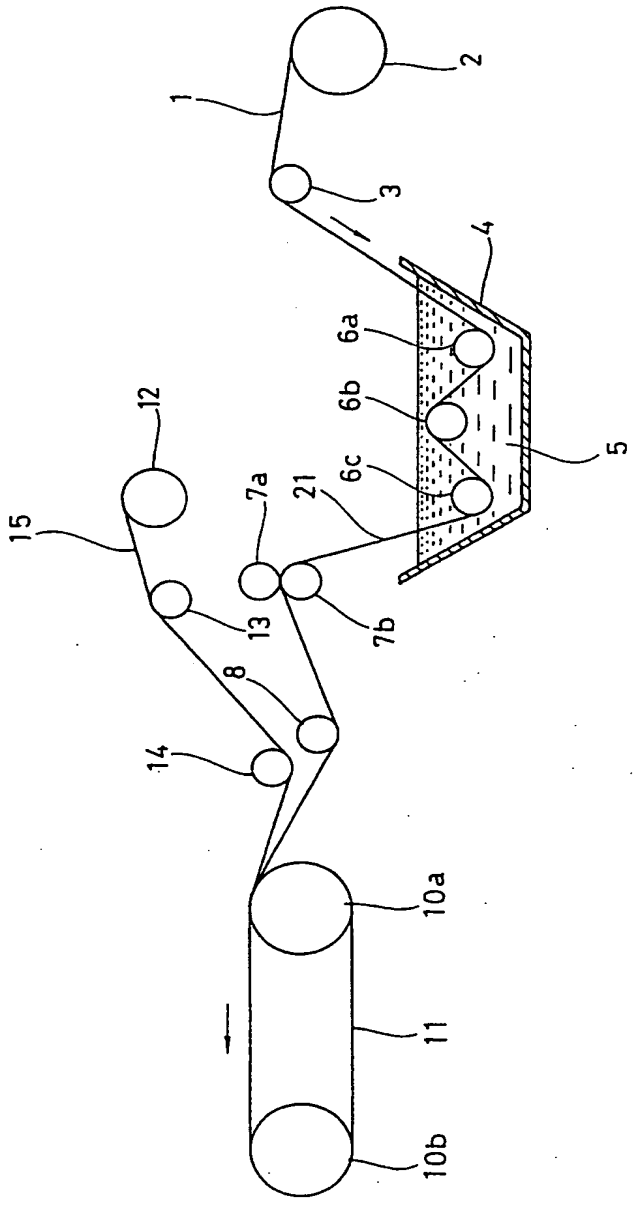


FIG. 5

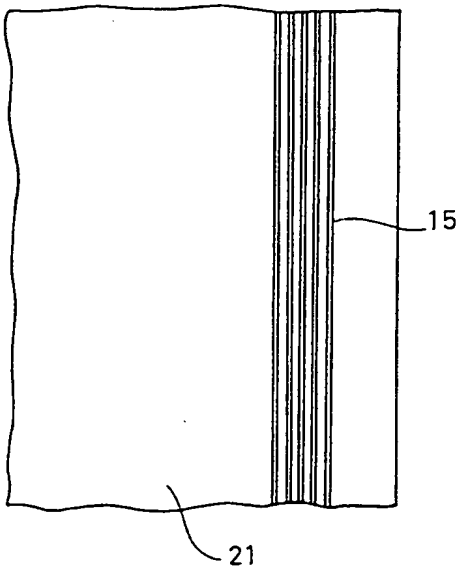


FIG. 6

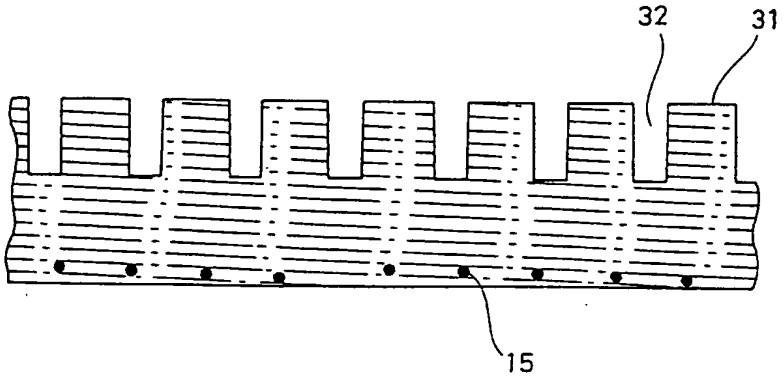


FIG. 7

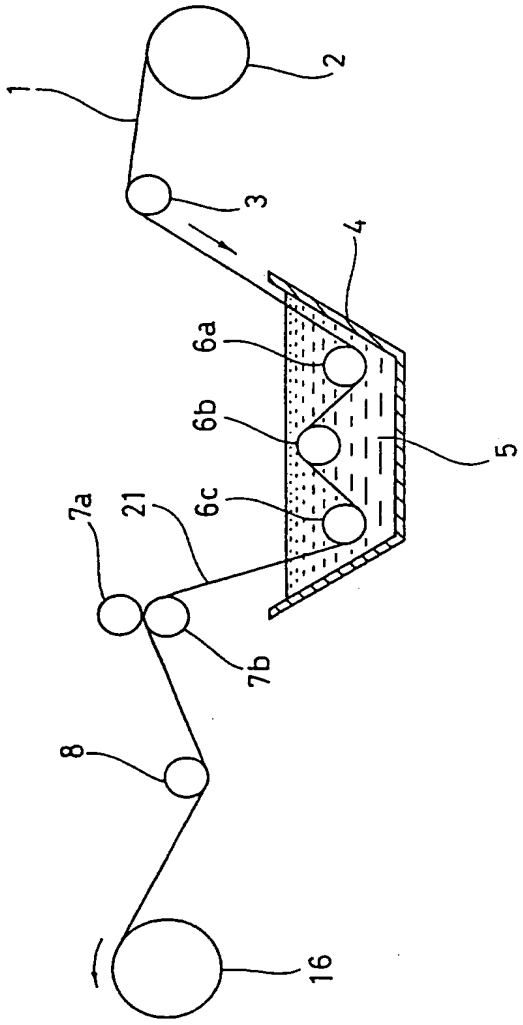


FIG. 8

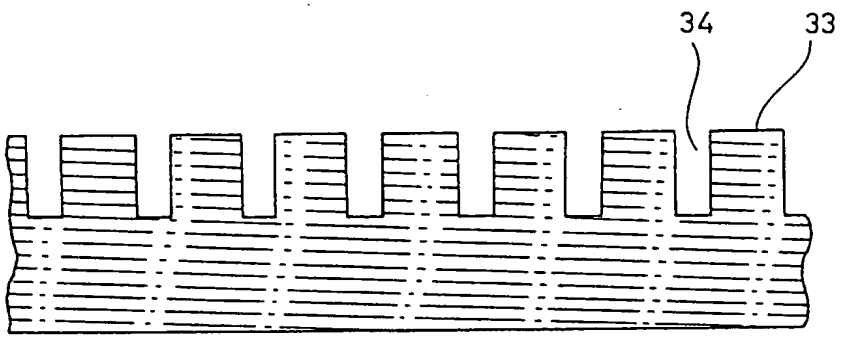


FIG. 9

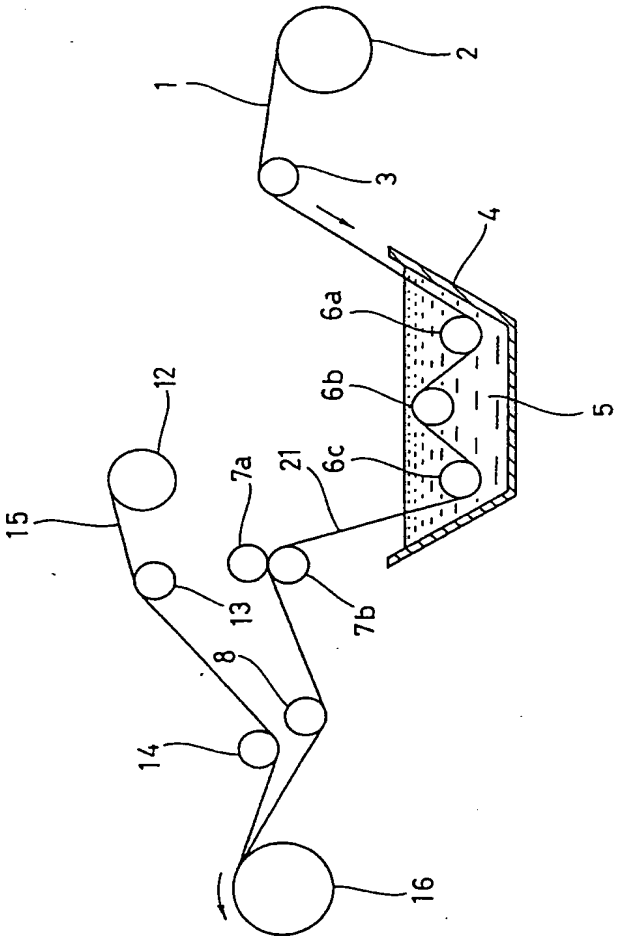


FIG. 10

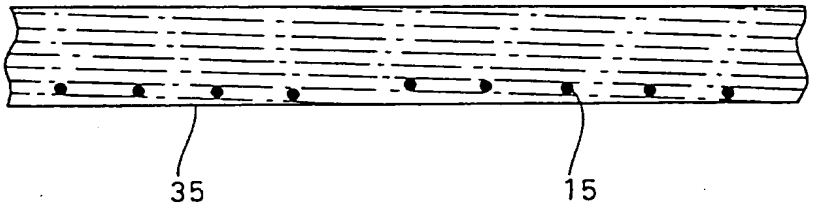


FIG. 11

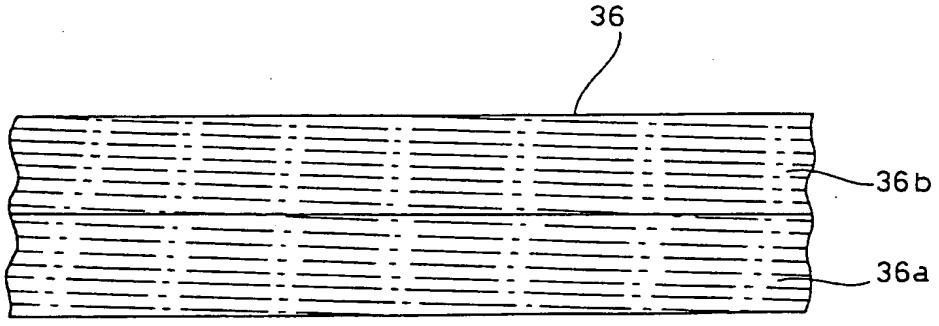


FIG. 12

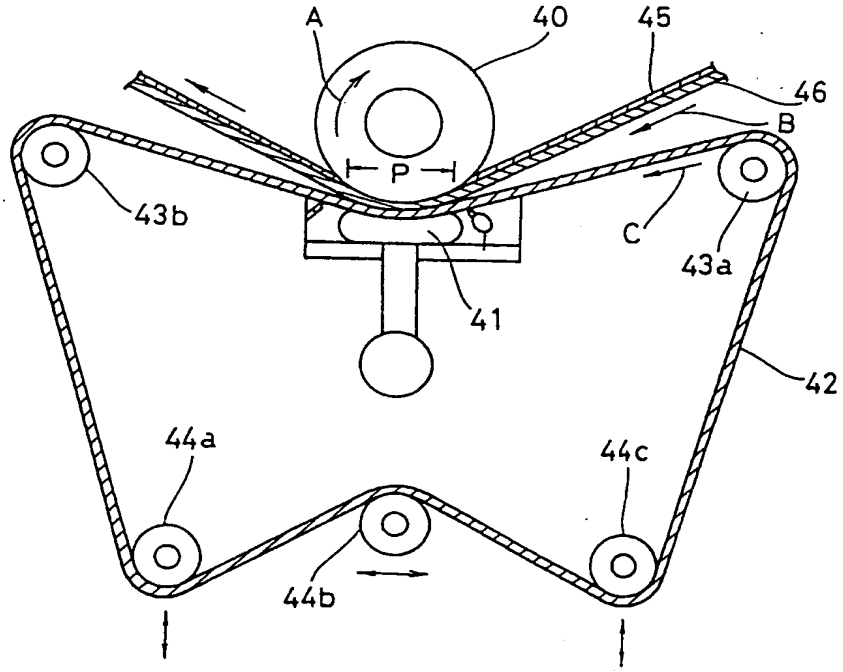


FIG. 13

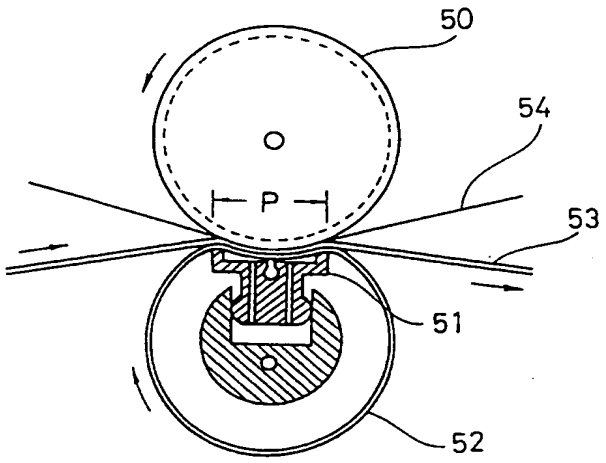


FIG.14

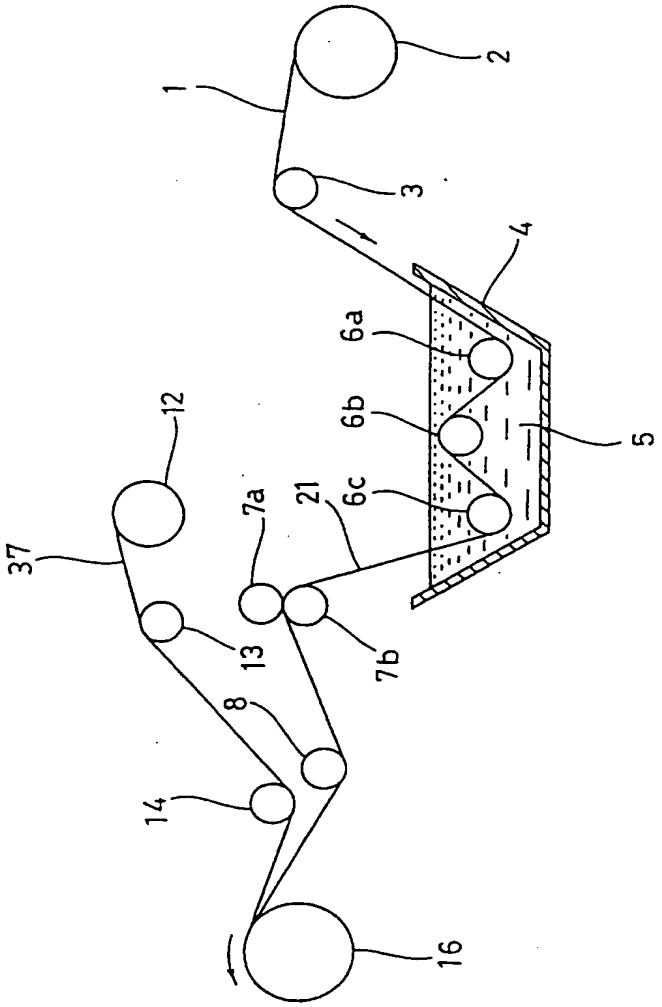


FIG. 15

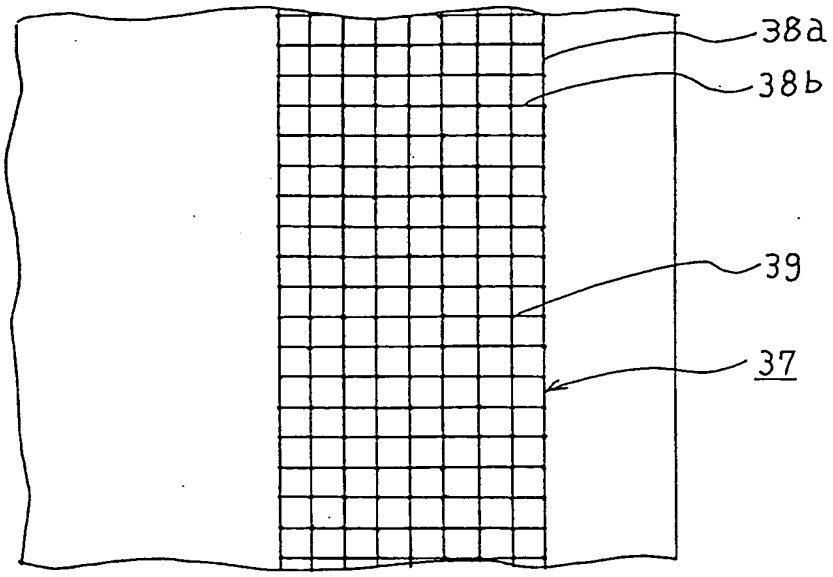


FIG. 16

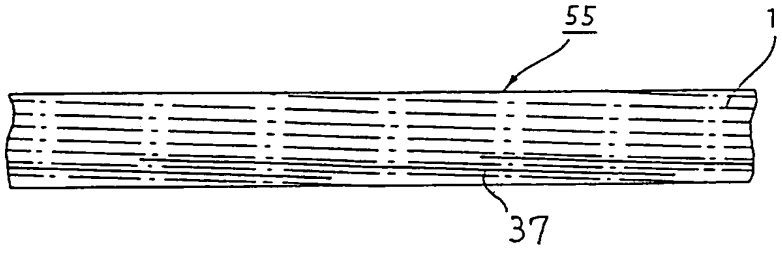


FIG.17

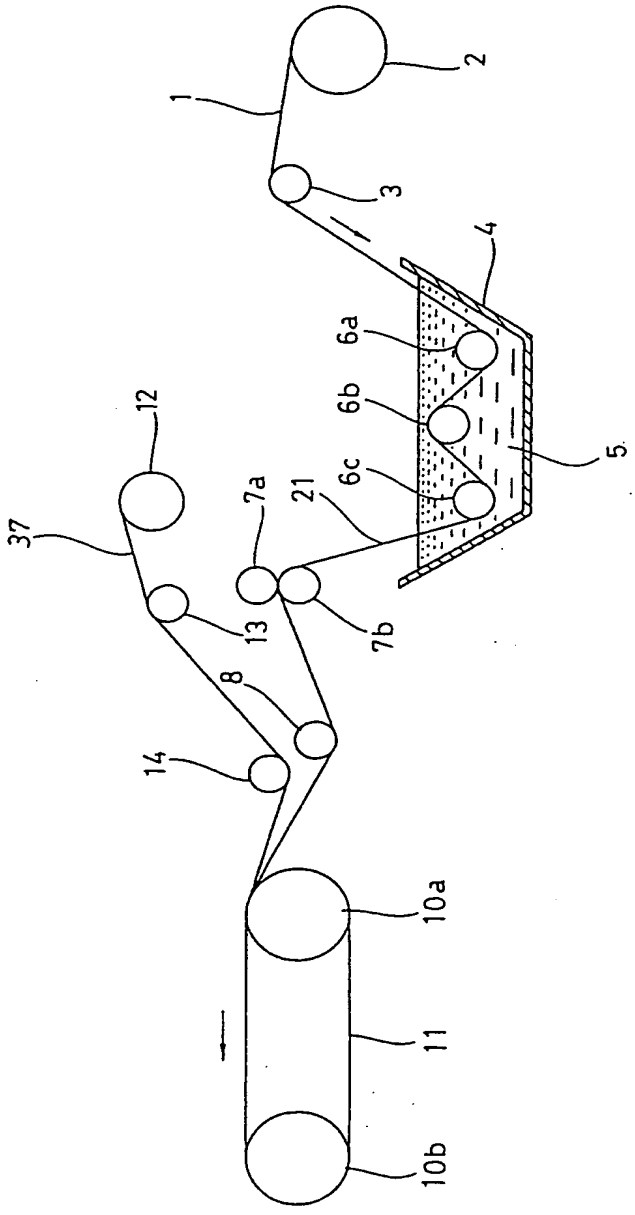
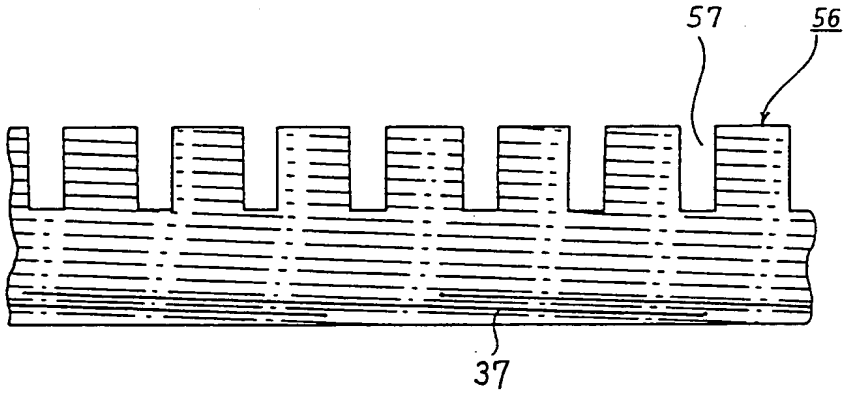


FIG.18



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 10 6453

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 336 876 (BELOIT) * the whole document *	1-12,23, 26-31,38	D21F3/02
A	EP-A-0 289 477 (VALMET PAPER MACHINERY) * column 9, line 50 - column 9, line 57; figure 6 *	1,12,13, 15,19, 20,23	
A	EP-A-0 396 035 (THOMAS JOSEF HEIMBACH) * the whole document *	13-18, 33,35	
A	US-A-4 701 368 (KIUCHI ET AL) * the whole document *	19-22	
D,A	US-A-4 946 731 (OUTT) * the whole document *	19-22	
D,A	US-A-4 908 103 (CRONIN ET AL) * the whole document *	24,25	TECHNICAL FIELDS SEARCHED (Int. Cl.5) D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 JULY 1992	DE RIJCK F.

CATEGORY OF CITED DOCUMENTS

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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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